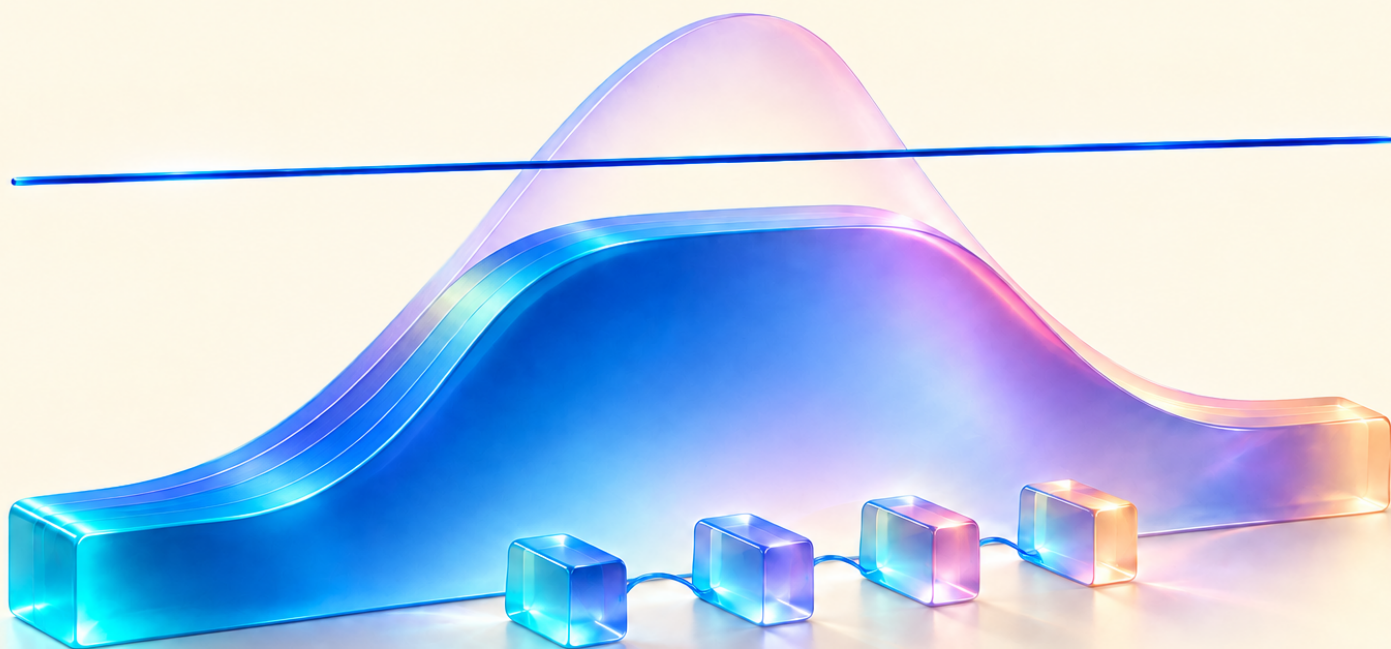


Distributed Capacity

Local battery relief for earlier data-centre operation



THE COMPLETE PROPOSITION

The proposal at a glance.

Distributed Capacity is a proposed, customer-funded service that uses batteries at electrically relevant commercial and industrial sites to reduce loading on a shared network constraint.

01	The problem	A data centre can have a capacity allocation and still be unable to use it because the local network cannot carry the extra power. Permanent upgrades can take years.
02	The service	Blue Whale coordinates a fleet of batteries to make room on the shared network during agreed hours. The batteries supply their host businesses, while the data centre continues drawing power from the grid.
03	Who pays	The data centre pays for the service. Its commitment helps finance the battery fleet, and host sites receive an agreed financial benefit.
04	Network protection	Network authorities decide how much extra power the data centre can draw, and on what terms. Independent controls at the data centre reduce its grid draw when the required relief is lost.
05	The next step	Blue Whale will run an industry-funded pilot in Q1 2027 with established AI data-centre customers. Distributed sites are already under construction.

The aim: speed to power – energising data centres sooner while permanent network upgrades are built.

READING THE PAPER

A local constraint. A coordinated response.

01	The constraint: getting power to the data centre	04
02	The solution: make room on the shared network	08
03	How Distributed Capacity works	14
04	Keeping the network safe	21
05	Who pays and what Singapore gains	24
	References	31
	Annex A	A-1
	Why battery location matters	

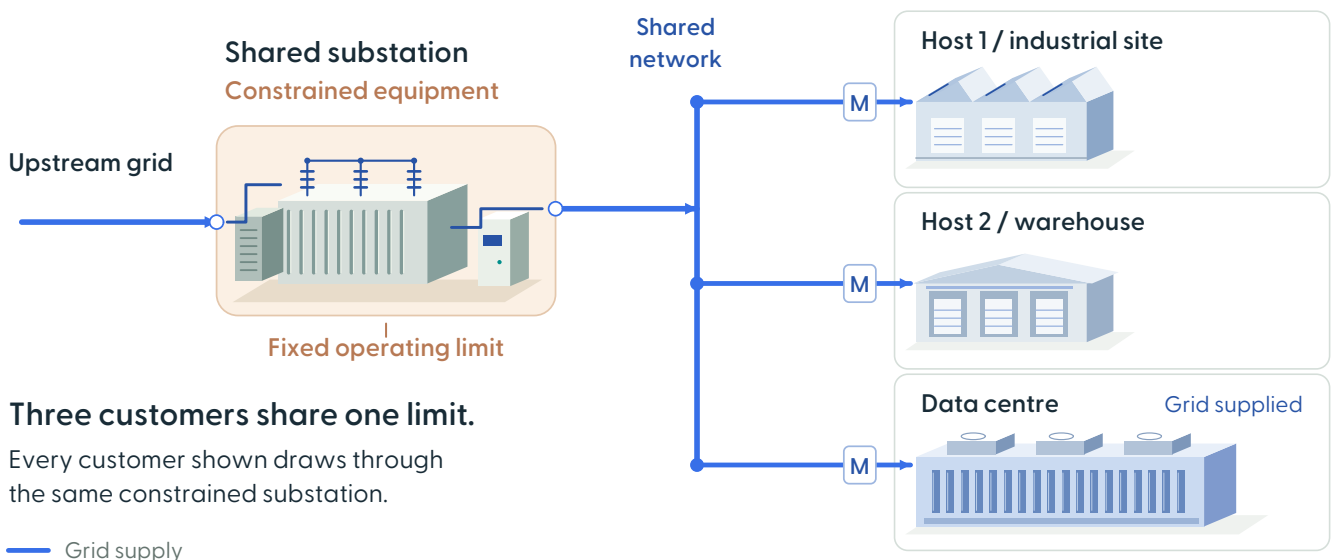
SECTION 01

The constraint: getting power to the data centre

Data-centre customers in Singapore have been awarded capacity but cannot yet energise their full allocation because of upstream network constraints.

Tens of megawatts across more than one operator are waiting for network upgrades.

The question is whether the network can carry more power to the data centre, at the times it needs it, while staying within safe operating limits.



Illustrative network. The shared substation is the constraint in this example.

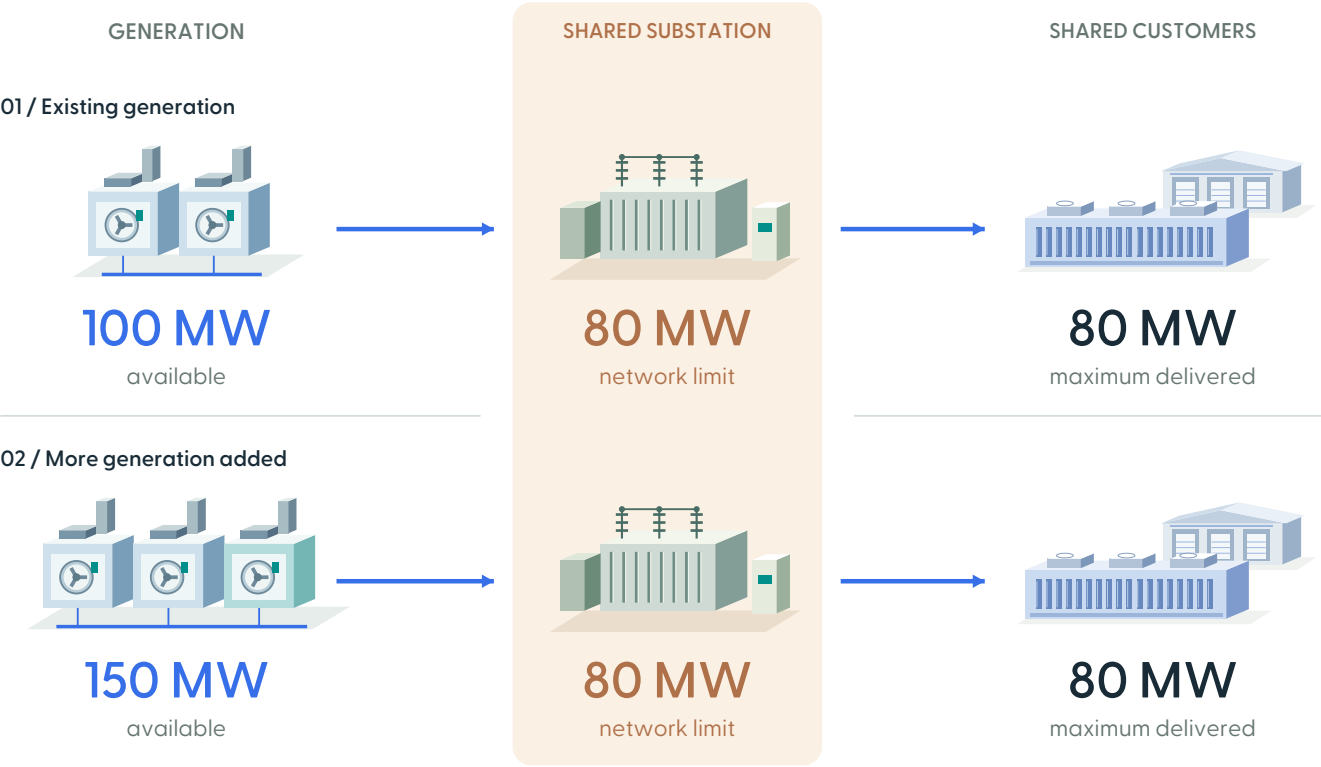
1.1 The bottleneck is in delivery

In a shared network, the equipment supplying a data centre also serves factories, warehouses, offices and other customers.

More power for the data centre has to pass through the same equipment. Once that equipment reaches its limit, extra generation elsewhere cannot solve this local bottleneck on its own.

WHY MORE GENERATION ISN'T ENOUGH

More supply. The same delivery limit.



Illustrative values at peak demand. More generation leaves the shared substation’s delivery limit unchanged.

POWER & ENERGY

MW Power supplied or used at a moment in time.

1 MW supplied for 1 hour = 1 MWh

MWh Energy supplied or used over a period.

The bottleneck is how much power the shared equipment can carry during its busiest hours.

We use an upstream substation as the working example. SP Group’s network assessment must identify the actual bottleneck, its operating limits and the customer connections it affects.

1.2 A few busy hours can hold up a connection

Shared equipment can have spare capacity for much of the day and still be unable to serve a new data centre. The connection is held up by the hours when their combined demand would exceed its limit.

LOADING AT THE SHARED CONSTRAINT

% of network limit · illustrative

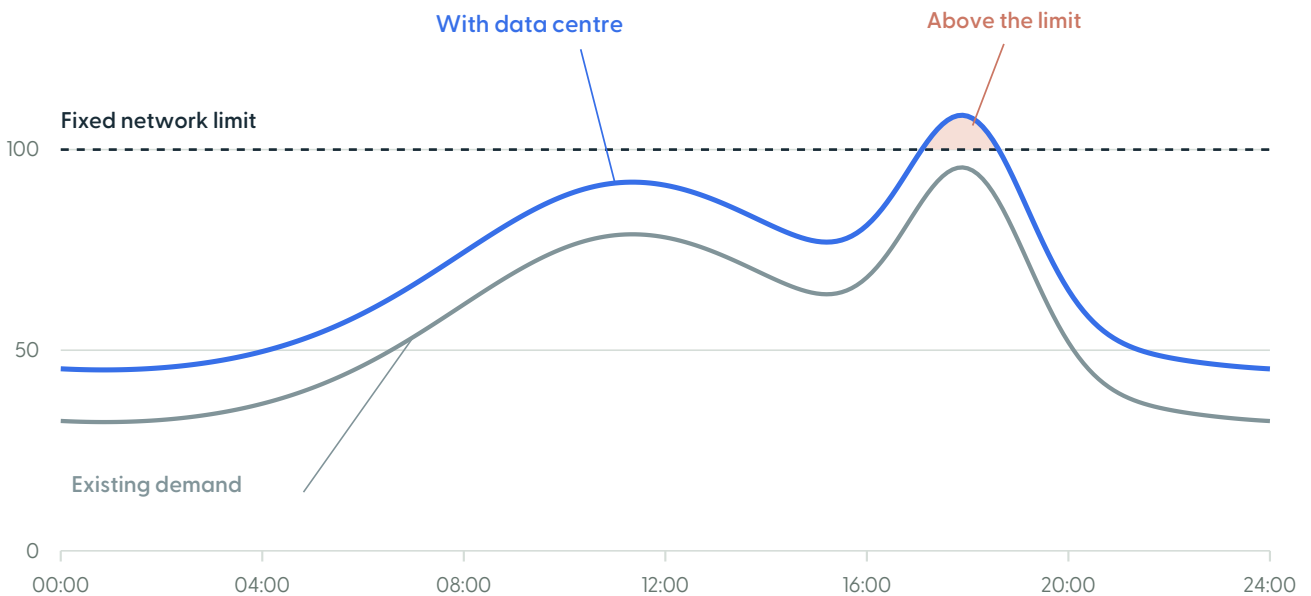


Figure 1. Without distributed relief. Stylised profiles; not measured network data.

In Figure 1, existing demand stays below the network limit. Adding the data centre raises loading throughout the day, but takes it above the limit only around the peak.

1.3 Network upgrades take time

Permanent upgrades are the long-term solution. More transformer capacity and new cable circuits allow the network to carry more power. Installing them involves major construction work and can take years.



Street-level excavation

Photo: SP Group



Work below ground

SPH Media Limited / SP Group

We propose using batteries to help data centres start operating while those upgrades are built.

OPERATIONS BROUGHT FORWARD



Schematic, not to scale. Timing depends on readiness, network approval and operating conditions.

We coordinate batteries as a virtual power plant (VPP). The data centre can draw extra power only within approved limits and while the required relief is available. Controls at its connection reduce its grid draw when that relief falls short.

SECTION 02

The solution: make room on the shared network

Batteries at other businesses can make room for the data centre.

We propose installing battery energy storage systems (BESS) at commercial and industrial (C&I) sites that draw power through the same constrained equipment as the data centre.



IKEA Tampines

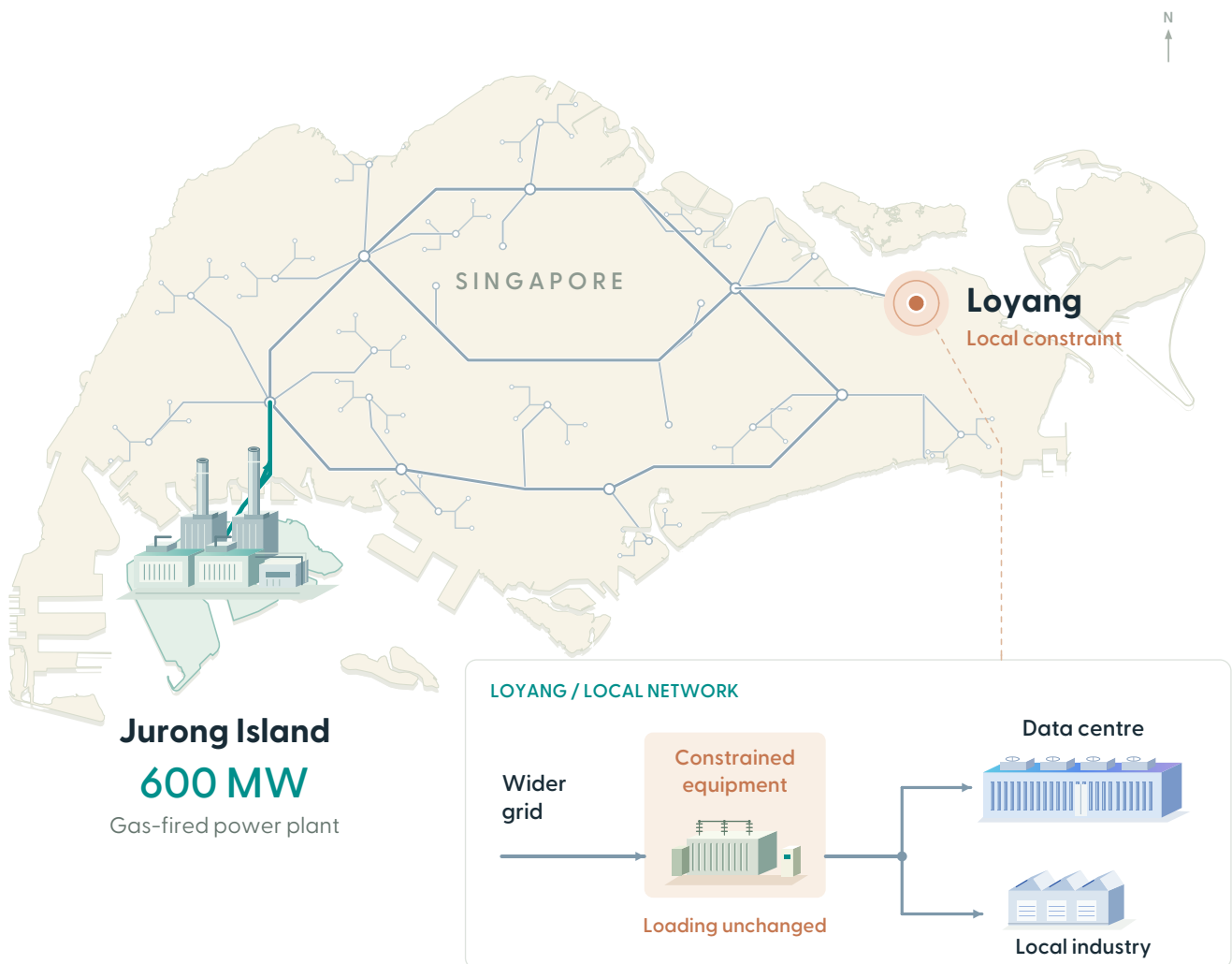
OPERATING DISTRIBUTED SITE

Batteries installed at this commercial host site and operated by Blue Whale Energy.

During busy hours, the batteries supply part of each host site's demand, reducing how much power it draws from the grid.

2.1 The battery must relieve the right equipment

A hypothetical 600 MW gas-fired power plant on Jurong Island supplies the wider grid. Loyang's demand still passes through the same constrained equipment, so the local bottleneck remains.



Hypothetical plant. Illustrative electrical paths and local constraint.

A battery helps only where it reduces loading on the constrained equipment.

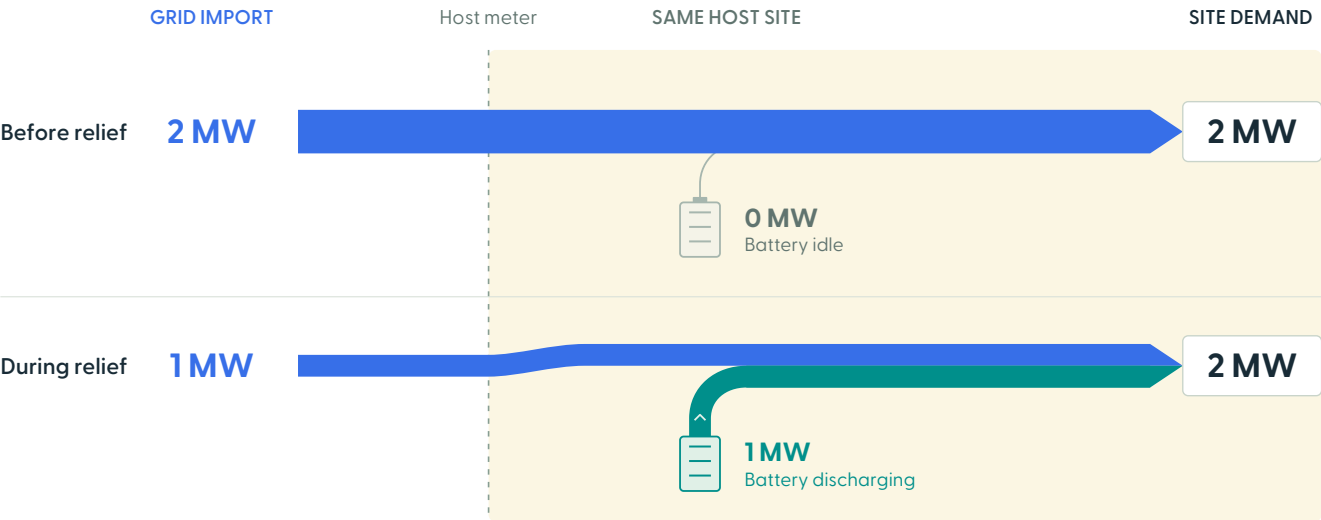
2.2 The host keeps running and draws less from the grid

Each battery connects behind the host’s electricity meter and supplies its internal electrical system.

The battery replaces part of the electricity the host would otherwise draw from the grid. The factory keeps producing, the warehouse keeps operating and people keep working in the office.

The business uses the same amount of electricity. It just draws less from the grid.

Same demand. Less grid import.



Ribbon widths are proportional to power.

The host doesn’t need to export electricity or run a cable to the data centre.

The benefit appears upstream: with hosts drawing less from the grid, the shared equipment carries less power. That makes room for the data centre, which continues to draw its electricity from the grid.

2.3

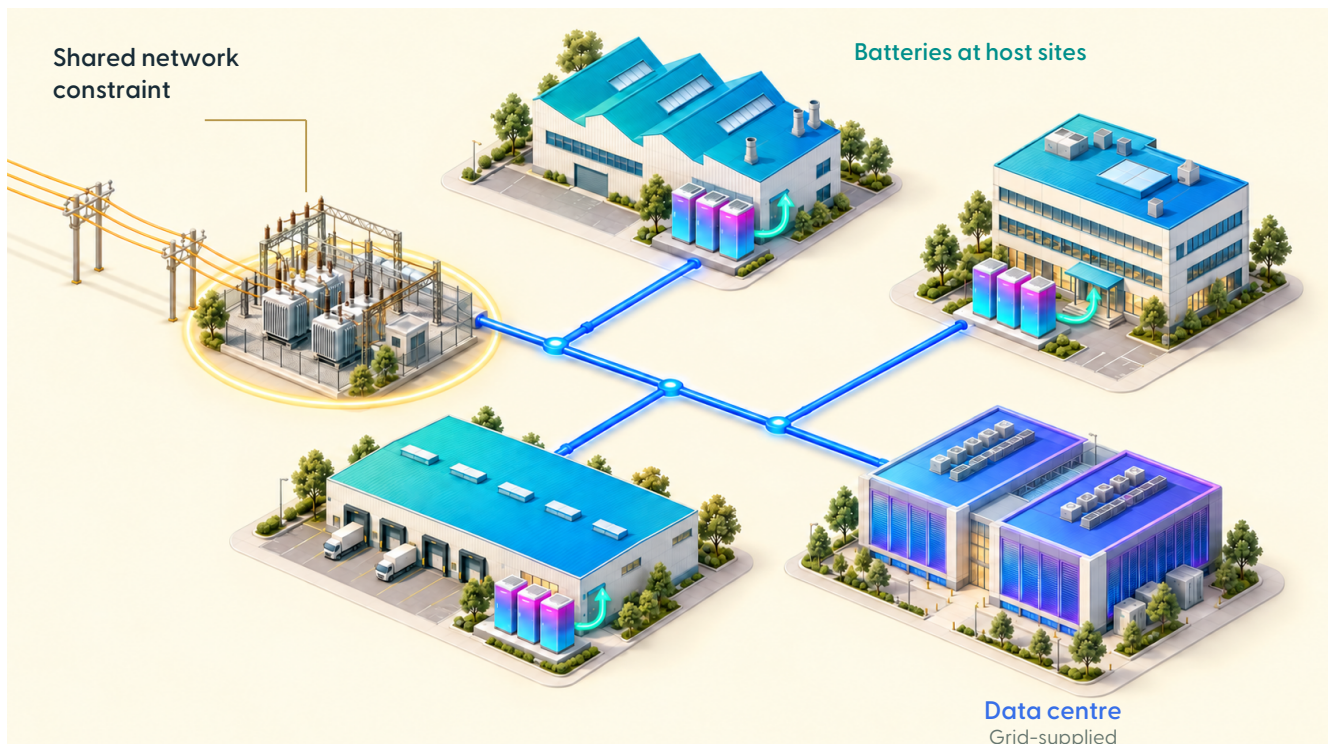
We run separate batteries as one fleet

One host may provide only part of the required relief. Our VPP software coordinates batteries across sites that relieve the same constraint, so we can manage their output together.

Host demand changes. Batteries differ in available power and remaining energy. We adjust each battery within its limits to keep the fleet delivering the required relief.

ONE FLEET. ONE SHARED NETWORK CONSTRAINT.

Worked example: Annex A



Batteries at host sites reduce demand on the shared equipment. Illustrative network; see Annex A for a worked example.

PROCUREMENT PRECEDENT / CON EDISON BQDM

Batteries to bridge the wait for reinforcement

Con Edison sought batteries serving host demand to relieve 138 kV feeders until a new substation opened.

15 MW

relief sought in the 2024 offering

4+ hours

consecutive delivery required

These were procurement requirements. Projects could not combine their capacity to meet the required rating, unlike our proposed fleet model.

[5] Con Edison, 2024 Participant Guide, pp. 4, 7.

2.4 Move grid demand out of the busiest hours

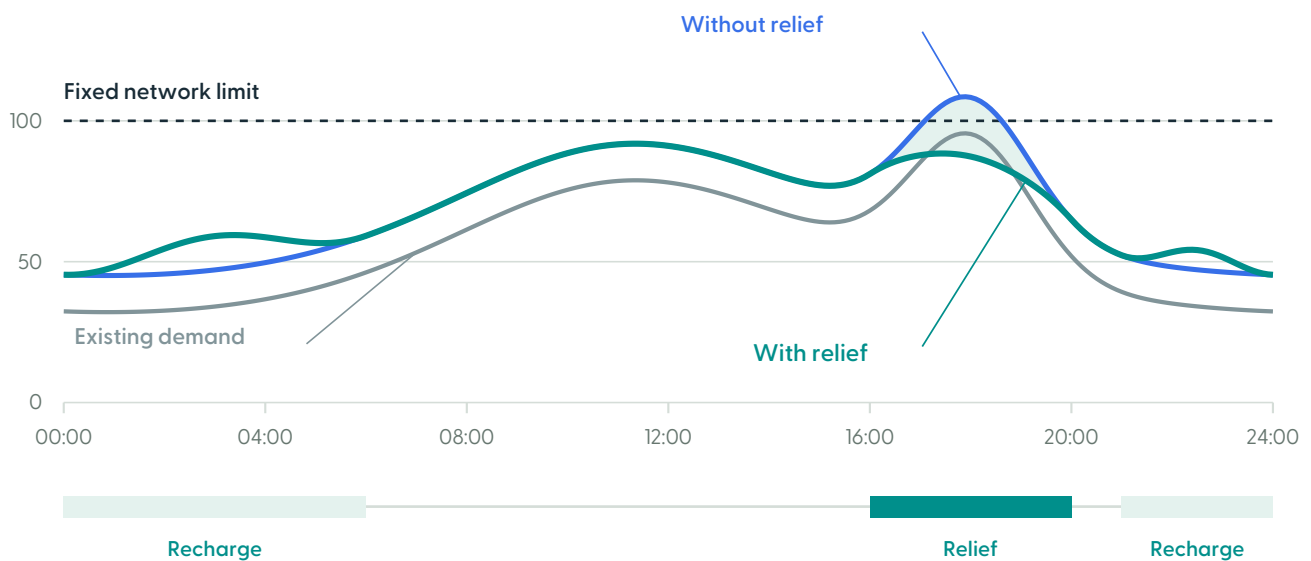
Figure 2 shows an illustrative day with an afternoon and evening peak.

During the peak, the batteries supply part of their hosts' demand. The hosts draw less from the grid, reducing loading on the shared equipment.

The data centre can draw its permitted demand throughout the peak while the fleet delivers the required relief. The batteries recharge when the network has room, within approved limits.

LOADING AT THE SHARED CONSTRAINT

% of network limit · illustrative



Recharge stays within available network capacity and approved limits.

Figure 2. Batteries shift grid demand out of the constrained hours. Illustrative profiles; charging stays within network limits.

This is the basis of Distributed Capacity: batteries reduce grid demand at the right sites, making room for the data centre on the shared network.

OPERATING EVIDENCE / UKPN LEIGHTON BUZZARD

One battery responding to local peaks

UKPN reports more than 150 exports during high demand from its Leighton Buzzard storage site.

6 MW / 10 MWh

installed storage

>150

high-demand exports reported

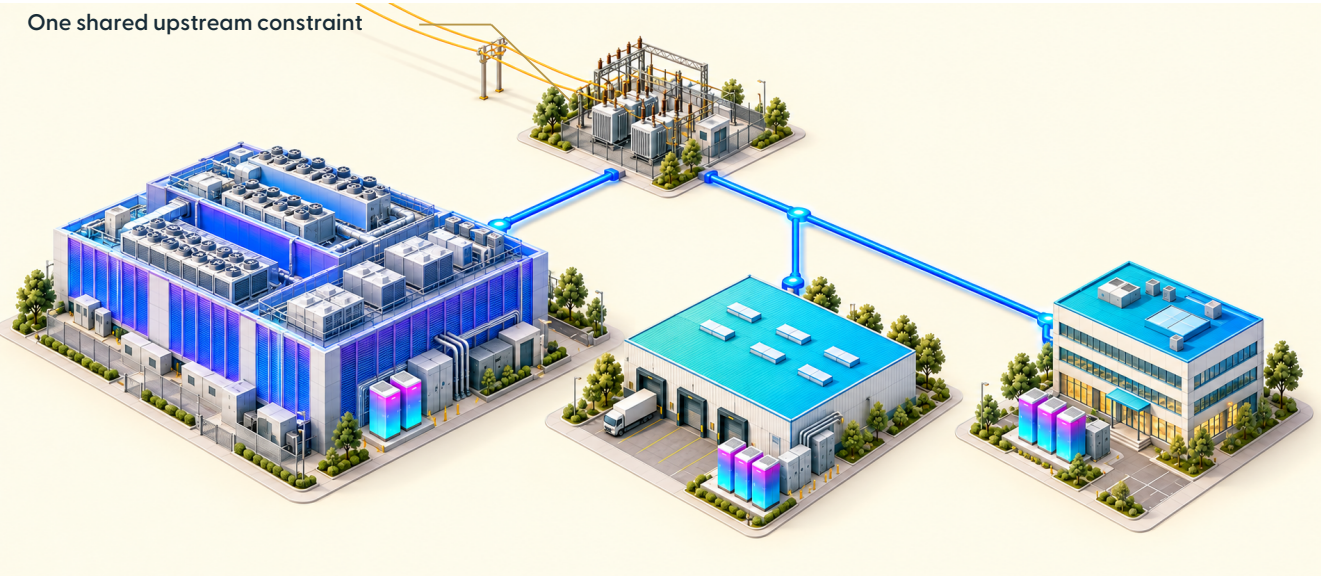
This is evidence from one site. It does not prove four-hour delivery at 6 MW or the reliability of a distributed fleet.

[6] UKPN, Smarter Network Storage project record.

2.5 Why distribute the batteries?

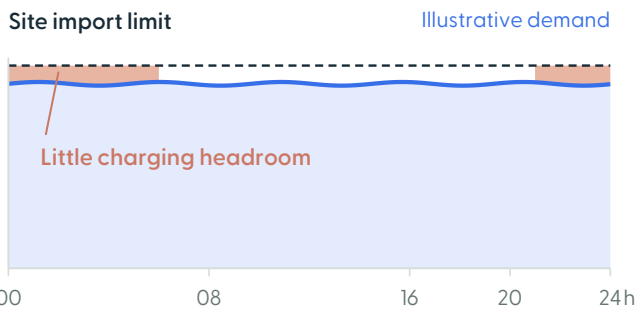
Host sites can offer space for batteries and room to recharge that the data centre lacks. A distributed fleet makes sense when it can deliver the required relief and recharge on better terms than the alternatives.

Space to install. Room to recharge.



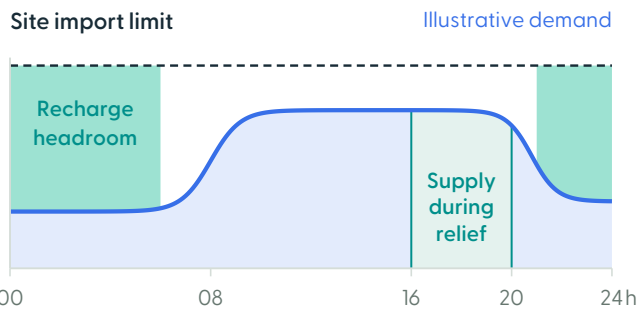
At the data centre

Limited room to install and recharge.



At suitable host sites

Combine space and recharge headroom.



Charging must stay within site and shared-network limits.

Illustrative profiles, each shown against its own site limit. Recharging must replace the energy used and cover losses.

CHECK THE ALTERNATIVES

On-site battery

Fits and recharges?

One larger site

One suitable site sufficient?

Customer flexibility

Curtailment or fallback acceptable?

Reinforcement

Available soon enough?

SECTION 03

How Distributed Capacity works

Turning a fleet of batteries into a service the network can rely on

Installing batteries is only the start. To be useful to the network, the fleet has to work as a service. It delivers a set amount of relief, at set times, in a way the network operator can check and control.

We call this standing locational relief: batteries at approved sites reduce loading on specific network equipment, by an agreed amount, during agreed hours.

This is the operating model we propose to develop with SP Group and EMA's Power System Operator (PSO). The service requires approval of its operating limits, interfaces and safeguards.

THE OPERATING COMMITMENT

01

The right place

Sites that relieve the constrained equipment

02

The right time

Stored energy ready for each service window

03

A measured result

Delivery checked against network measurements

3.1

The batteries run every weekday by default

We propose starting with a fixed schedule. The fleet delivers relief every weekday from 16:00 to 20:00, unless the network operator changes or cancels it.

PROPOSED WEEKDAY SERVICE



16:00–20:00 delivery; recharge stays within agreed limits.
Timing outside the relief window is illustrative.

The batteries don’t wait for a price spike or a call each afternoon. We hold back the energy they need, get the fleet ready and deliver as a matter of routine.

The 16:00–20:00 window is a starting point. The actual constraint hours may differ; SP’s network data will determine the right window.

Why a fixed schedule rather than on-call?

When the constraint is predictable, a fixed schedule is simpler to run. The network operator supervises and steps in when needed, without having to trigger every discharge.

It also builds a track record. Every service day shows whether the fleet delivered the required relief, held it for four hours and recharged in time for the next obligation.

The cost is that the batteries hold energy back and cycle even on days when less relief is needed. Con Edison’s Brooklyn–Queens programme instead calls on batteries for summer events, with at least 21 hours’ notice.[5]

As network and operating data builds up, we can assess a more targeted schedule.

3.2 **What counts is relief at the constraint**

We measure the commitment where it matters: as a reduction in load on the constrained equipment.

A battery counts only as far as it relieves that equipment. If the network is reconfigured, its contribution can change.

1 MW × 4 hours = 4 MWh

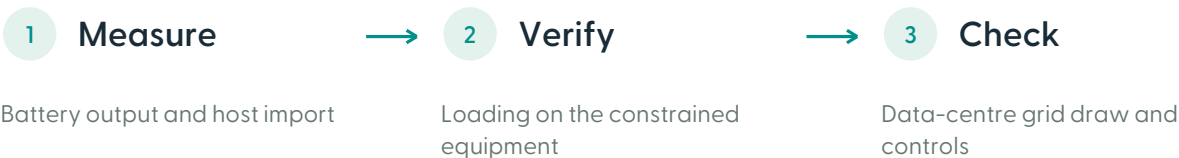
Usable AC energy at the battery terminals

Duration matters as much as power. Delivering 1MW for four hours needs 4 MWh of usable AC energy at the battery terminals. Installed capacity must also cover losses, reserves and ageing.

So 10 MW of installed batteries does not mean 10 MW of dependable relief. And 10 MW of relief does not automatically let the data centre draw 10 MW more. Each figure is worked out separately.

Installed MW ≠ Dependable relief ≠ Additional import

CHECK WHAT THE BATTERIES ACTUALLY DELIVER



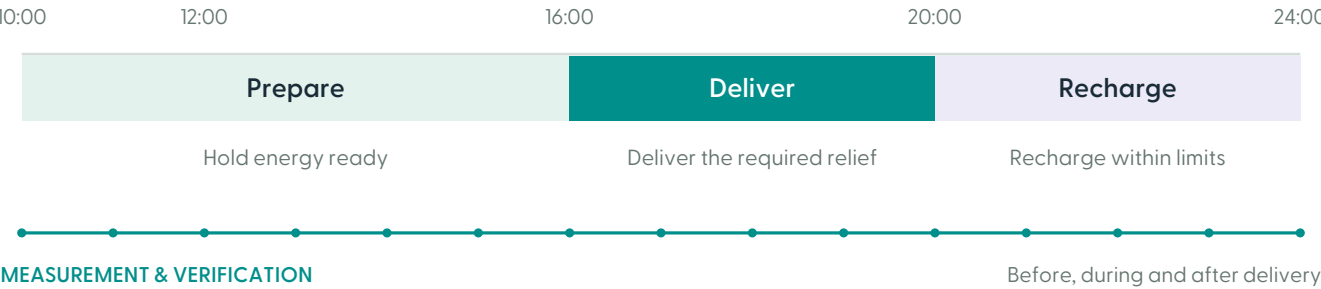
Use the measurement and verification method agreed with the network operator.

3.3

A normal service day

We prepare, deliver and recharge, with measurements checked throughout the day.

PROPOSED WEEKDAY SERVICE



Timing outside the relief window is illustrative.

Prepare: check the fleet can deliver

- Before the window opens, we check that:
- The fleet has enough stored energy and output.
 - Host sites have enough demand for the batteries to offset.
 - Equipment, communications, meters and connection safeguards work.

If we expect a shortfall, we bring in other approved batteries or agree a lower import limit. The data centre reduces its grid draw accordingly before the window begins. It never relies on relief we already know is missing.

Deliver: run the fleet as one

A host’s demand drops, a battery goes offline, or some batteries run lower on energy than others. We adjust individual batteries, within their limits, to keep the fleet’s relief on target.

Verify: check delivery throughout

The network operator receives the measurements needed to confirm delivery and see network conditions, using the agreed verification method.

Recharge: get ready for the next day

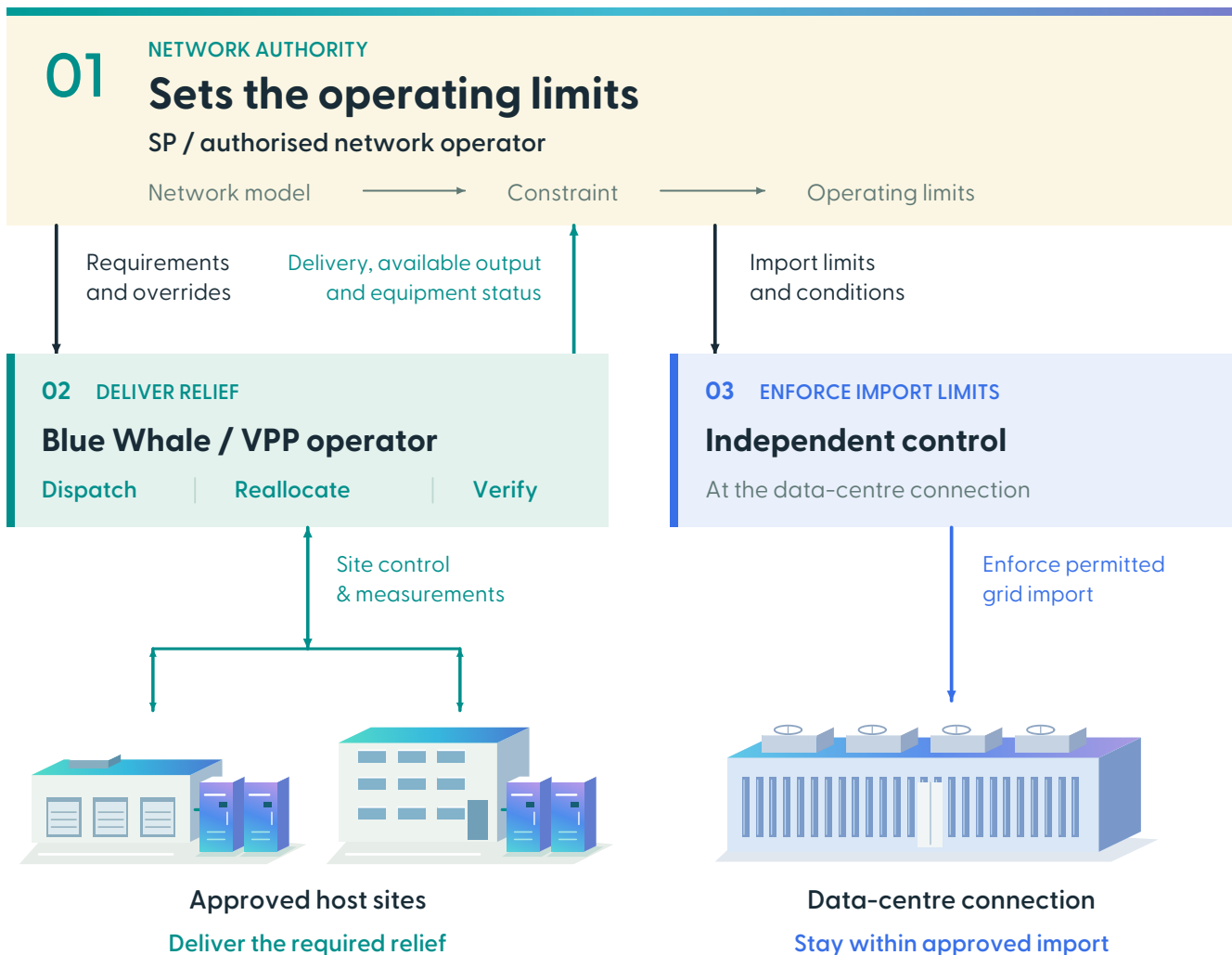
After the window, we reduce discharge and recharge under the approved plan, within each host’s limits and the network’s spare capacity. We must be ready for the next obligation. Reaching 20:00 is not a signal to charge flat out.

3.4

The network operator sets the limits; we run the fleet

The network operator decides what relief is needed and sets the limits. We run the batteries to deliver it.

SP and the PSO retain their respective network and system responsibilities. The PSO is responsible for reliable supply and stable power-system operation, including emergency response. Our job is to dispatch batteries, hold back energy, arrange substitutes, maintain the fleet and report performance.



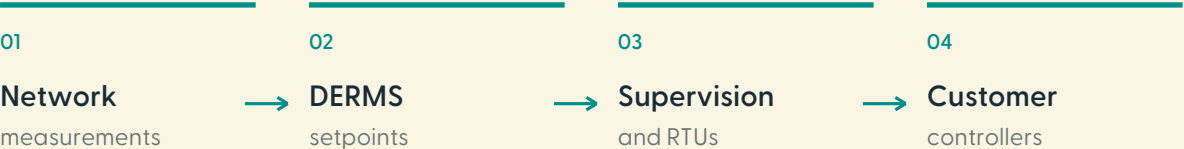
Proposed instructions and reporting. Electrical supply paths are omitted.

CONTROL PRECEDENT / UKPN FLEXIBLE CONNECTIONS

Connect earlier with a controllable import limit

UK Power Networks lets some customers connect earlier on condition that their import can be controlled. Its distributed energy resources management system (DERMS) uses network measurements to calculate limits, then sends them through its control systems to equipment at the customer’s site.[3]

UKPN CONTROL CHAIN / PRECEDENT



UKPN demonstrates controlled access. Singapore must still approve and test the proposed interface to our fleet.

[3] UKPN, Curtailment and DERMS.

We propose the same split between network supervision and customer-side control, adapted for a battery fleet.

SP’s systems tell our platform how much relief is needed and where. We spread delivery across the batteries and report back on output, remaining capability and equipment health. The link also carries operator overrides and information about individual sites.

SP has described piloting a DERMS to monitor and control distributed resources, including storage. The interface for this service still needs to be agreed.

What an override means

The network operator can change the required relief, limit charging, exclude sites that no longer relieve the constraint, or reduce the data centre’s import limit.

Those instructions always come before our commercial plans.

We propose to build and maintain the customer-side software and interfaces, so utility staff don’t have to operate individual batteries.

The overseas examples support individual parts of the model. We still have to prove that they work together under Singapore's network and commercial conditions.

3.5 **Extra capacity while the batteries deliver**

The connection has two parts: a normal allowance that the data centre can use without battery relief, and an extra amount it can use while the required relief and safeguards are in place.

On a normal day, the fleet delivers and the data centre draws its full permitted amount from the grid.



Schematic. The normal allowance can vary with time and network conditions. The extra allowance requires network approval.

If relief falls short, the extra allowance shrinks. If relief stops, it is withdrawn. The data centre must reduce its grid draw to the new limit within the approved response time.

The arrangement depends on reliably reducing grid draw when relief is lost. Section 4 explains how.

SECTION 04

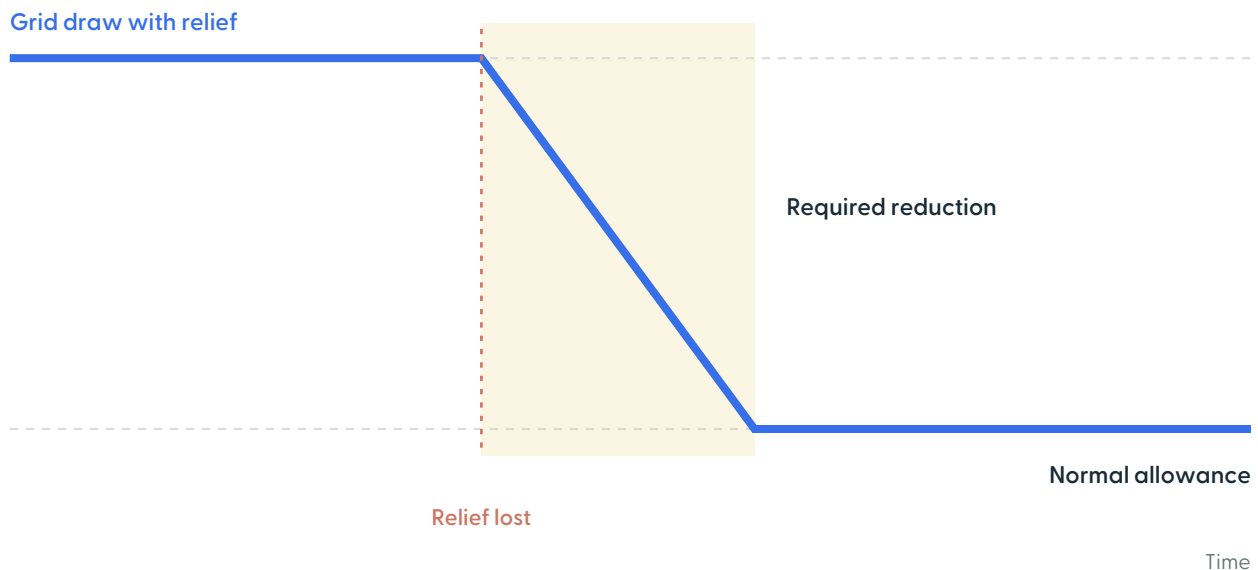
Keeping the network safe

What happens when the batteries don't deliver?

Batteries, communications links and controllers can fail. The service needs a clear response when relief falls short or can no longer be verified.

If the fleet cannot provide the required relief, the data centre must reduce its grid draw. Independent controls at its connection enforce that limit.

THE IMPORT RESPONSE



Conceptual response. The connection agreement sets the response times, tolerances and protective actions.

4.1 Match the response to the failure

One failed battery may be covered by the rest of the fleet. A loss of measurements or a failed import controller needs a different response. We agree the triggers, tolerances and response times before the service starts.

EVENT	PROPOSED RESPONSE
One battery becomes unavailable	We replace its contribution where other approved batteries have enough power, energy and response capability.
Host demand or stored energy is too low	We shift delivery to other batteries. If a shortfall remains, the data centre reduces its grid draw before it exceeds the supported limit.
The relief shortfall exceeds the tolerance	The data centre reduces grid draw within the required response time. The response cannot wait for a later financial settlement.
Communications or measurements are lost	The agreed fallback mode takes over. If its conditions no longer hold, or its time limit is reached, the data centre reduces grid draw to the required limit.
The network configuration changes	We follow the revised instruction and check which batteries still provide useful relief. The data centre follows the revised import limit.
Import controls fail to reduce grid draw	Independent protection acts, including disconnection where specified.

A running battery still needs to be checked

If a battery loses its central communications link, healthy local controls continue the approved stored schedule for the specified interruption period.

But continued discharge alone cannot justify extra import indefinitely. If delivery cannot be verified, the agreed fallback limits apply and grid draw must fall accordingly.

We set the rules for missing, stale or conflicting data in advance, including how long operation may continue before import is reduced.

UKPN likewise uses different responses for failures at different points in the communications chain, with local safeguards and escalating control actions.[3]

4.2

A local backstop at the data centre

The final backstop sits at the data-centre connection. It controls grid import locally and must work even if our central platform or wide-area communications fail.

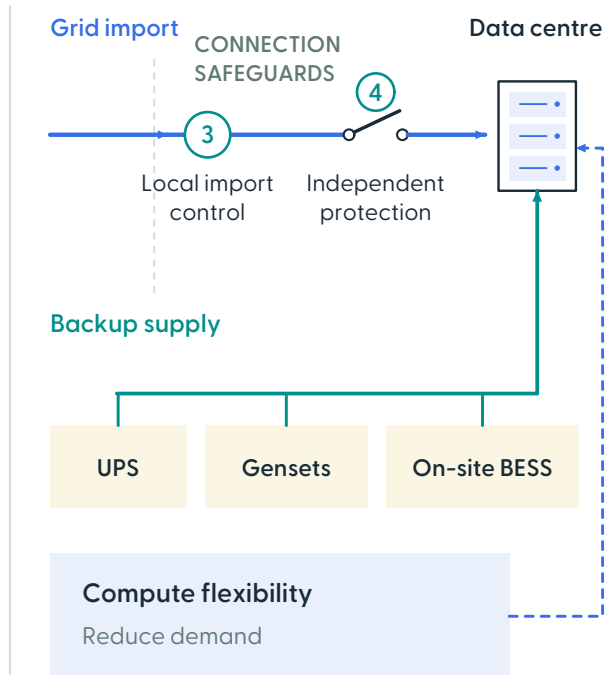
NETWORK PROTECTION

- 1 **Replace lost relief**
Other approved batteries take over where capacity is available.
- 2 **Reduce the import limit**
Relief falls short or can no longer be verified within the agreed time.

AT THE DATA-CENTRE CONNECTION

- 3 **Local import controller**
Enforces the local import limit without central communications.
- 4 **Independent protective action**
Disconnection where specified if import is not reduced.

CUSTOMER CONTINUITY



Where practical, the controls remove only the extra import. If they fail to achieve the required reduction, independent protection acts, including disconnection where specified.

UPS, gensets or on-site BESS can cover the resulting supply gap, within their available power, energy, fuel and operating limits. Compute flexibility can also reduce demand by slowing or deferring suitable workloads within agreed service limits. The data centre must plan for those limits and reduce its demand when needed.

The fleet creates room for extra grid use. The connection safeguards keep grid draw within safe limits when that relief is lost.

SECTION 05

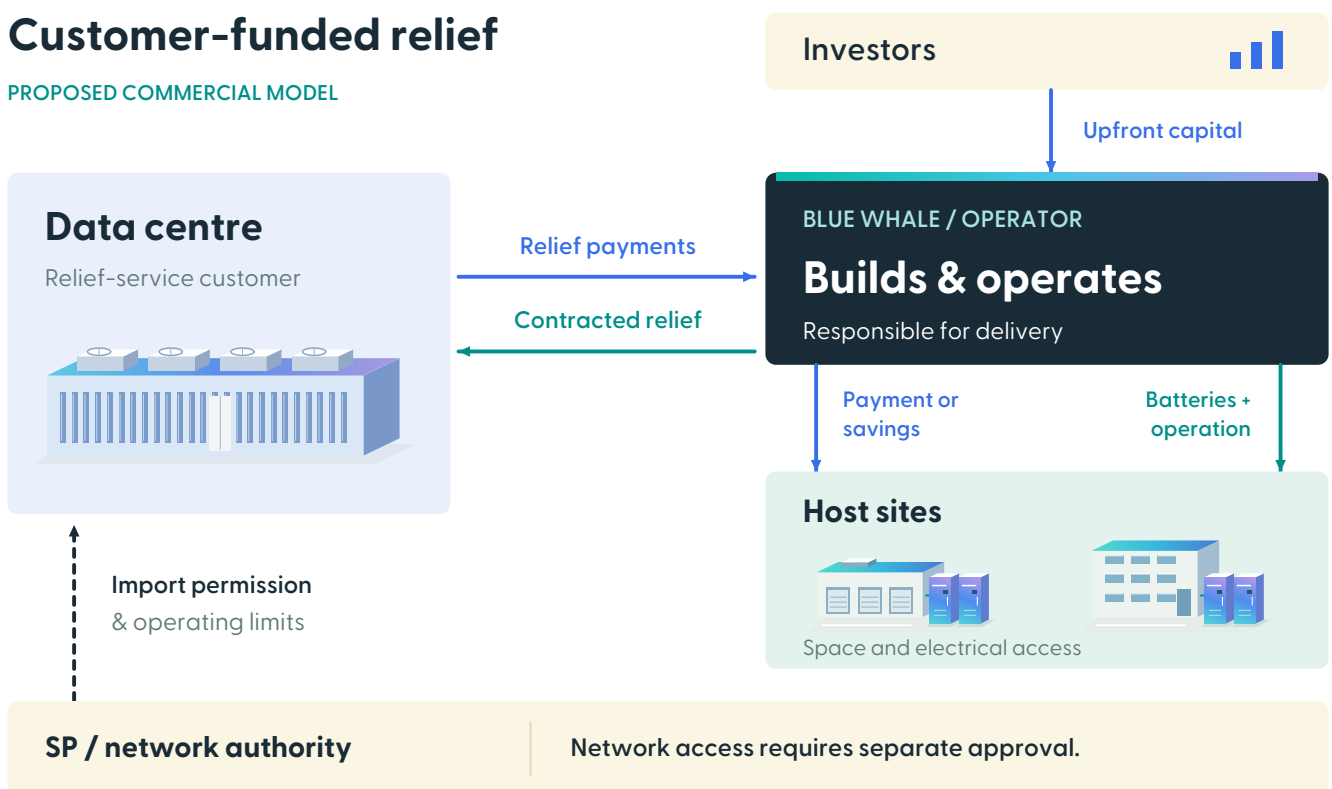
Who pays and what Singapore gains

The data centre pays for network relief so it can operate sooner. Its contract helps finance batteries at commercial and industrial sites, and those businesses receive an agreed financial benefit for hosting them.

As developer and aggregator, we build and run the battery fleet. SP and the relevant authorities retain control over network access and operating limits.

Customer-funded relief

PROPOSED COMMERCIAL MODEL



Proposed roles. A qualified developer or aggregator can provide the service. Arrows show payments, services and permissions.

The data centre gets an earlier start. Its payments help fund a fleet that can also serve other electricity-system needs, where the batteries and network allow.

5.1 **Earlier operation gives the customer a reason to pay**

When the facility and its customers are ready, waiting for power delays revenue. Paying for relief makes sense when the value of operating earlier outweighs the fees, other costs and risks.

EARLIER OPERATION / ILLUSTRATIVE ECONOMICS



20 MW

Additional grid import

÷ 1.25

Assumed PUE

= 16 MW

Corresponding IT capacity

= 16,000 IT kW

16,000 IT kW × US\$330 per month × 12 months

Revenue, not profit or the budget for relief. Assumes the capacity is built, fully leased and operating for a full year. PUE is total facility energy divided by IT-equipment energy; 1.25 is assumed at the relevant load. The 20 MW is extra data-centre grid import. Installed battery capacity and verified network relief are separate figures.

An assumed sensitivity. If 60% of revenue remained after extra operating costs, about US\$38 million a year would remain before relief fees, other investment costs and risks. That is US\$1.9 million per additional grid MW-year. The 60% is an assumption, not an estimate of industry margins.

Rental benchmark: CBRE, Global Data Center Trends 2026, Q1 2026 data. The calculation uses the lower end of the reported Singapore range of US\$330–475 per kW per month.

What the customer buys

We commit to reducing the load on specific network equipment by an agreed amount, at agreed times and within agreed limits. The data centre pays for that relief and still draws its electricity from the grid. Our service contract must match the network-approved connection terms; it does not grant permission to draw more power.

The commercial question is how much of the value of starting earlier can fund the relief needed to make it possible.

VALUE RECOGNITION / NEW YORK LSRV

New York pays for relief in the right place

New York’s Value of Distributed Energy Resources (VDER) framework pays separately for locational relief, energy and system capacity. Its Locational System Relief Value (LSRV) gives eligible resources, including batteries, extra bill credits at designated substations. Each location has a limit on the capacity that can qualify. [7, 8]

LSRV credits eligible exports. Our proposal instead has the data centre pay for relief from batteries serving host demand without exporting.

[7] NYSERDA guide, pp. 2-4. [8] National Grid, January 2026 statement.

5.2 The customer contract helps finance the fleet

The customer pays for the service without having to own every battery. In our proposed model, the developer and its investors fund installation, while the customer makes recurring payments. The developer and aggregator are responsible for delivering the whole service.

A long enough contract can help secure that investment. Investors will assess the customer’s credit, the payment terms, the contract length and what happens if the service falls short.

Other battery earnings come second to the relief commitment. We cannot promise the same power, stored energy or recharge time to another service if that would prevent us from delivering the relief.

WHAT THE SERVICE FEE SUPPORTS

01 Build the fleet	02 Run the fleet	03 Keep it ready
Batteries and suitable sites; electrical integration and commissioning.	Host payments, charging energy and losses; maintenance and insurance.	Meters, communications and controls; spare capacity and battery ageing.

5.3

Host businesses share in the value

Host businesses earn an agreed financial benefit for helping the data centre start operating earlier.

THE SAME BUSINESS. AN ADDITIONAL SOURCE OF VALUE.



01 / Host contribution

Suitable space and electrical access.

02 / Developer provision

Battery installation and service operation.

03 / Host benefit

An agreed payment or other defined financial benefit.

A clear agreement at each site

Each host and developer agree who handles installation, access to the site and electrical equipment, and day-to-day operation.

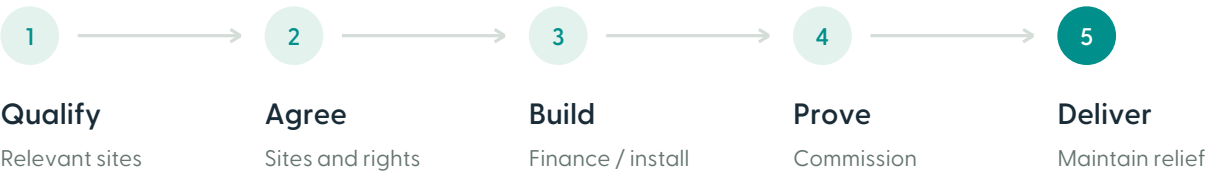
The host's benefit can be a payment, a share of earnings from compatible services, or savings on contracted capacity charges and other tariffs where these apply.

5.4 **SP can call on an installed fleet**

We assemble and run the fleet, including the agreements with each host. SP gains access to batteries that are financed, installed, checked for the required service and ready to respond to its instructions under the approved arrangement.

Where the network connections allow, the fleet can relieve a feeder, distribution equipment or a shared upstream constraint. The approved arrangement must set out SP's and the PSO's authority, which instructions take priority, and what happens if delivery fails. Sections 3.4 and 4 explain the proposed controls and safeguards.

FROM SUITABLE SITES TO A WORKING BATTERY FLEET



EVIDENCE / UKPN NETWORK INVESTMENT

£94m

Avoided or deferred reinforcement costs

12 HV sites + 114 LV sites / 2020/21 prices

UK Power Networks reports £94 million of avoided or deferred reinforcement costs across 12 high-voltage and 114 low-voltage sites, in 2020/21 prices. [9] It assesses each site and counts a benefit only when the flexibility it buys meets the full capacity requirement. This is a programme-wide network estimate, not provider revenue or a Leighton Buzzard result. Savings and extra import capacity in Singapore need their own assessment.

Payment never replaces the physical safeguard.

A service credit can compensate the customer for a shortfall. The data centre must still reduce its grid draw when required. Paying compensation does not remove that obligation.

5.5 **Singapore gains useful infrastructure**

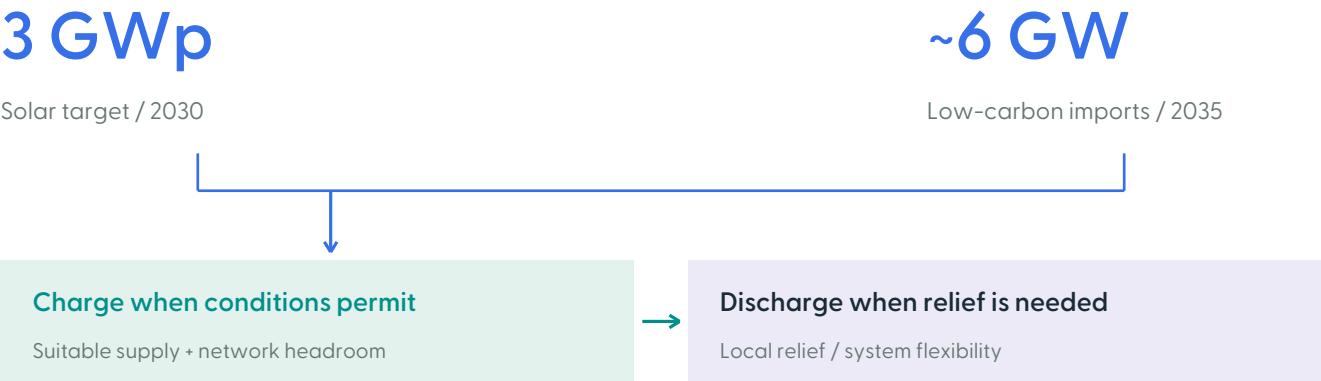
Earlier data-centre revenue explains why the customer pays. The wider case for Singapore depends on what that investment achieves.

That means assessing what starts producing value sooner, what host businesses earn, and which useful assets and operating capabilities remain beyond the first customer's need.

Batteries with more than one use

Singapore needs flexibility beyond the constraints discussed here. Its solar target is 3 GWp by 2030, and it aims to import around 6 GW of low-carbon electricity by 2035.

SUPPLY IS CHANGING



EMA and SP's Future Grid Capabilities Roadmap identifies distributed resources as a source of energy, ancillary services and demand response. It also calls for better grid control as renewable supply grows.

Batteries at host sites can help. They charge when supply and spare network capacity allow, then reduce demand on the grid when supply is tighter or local loading is higher.

Data-centre contracts can help bring those batteries into service sooner.

The first job is to make room on constrained network equipment. The same assets can support other services where the batteries, network and existing commitments allow.

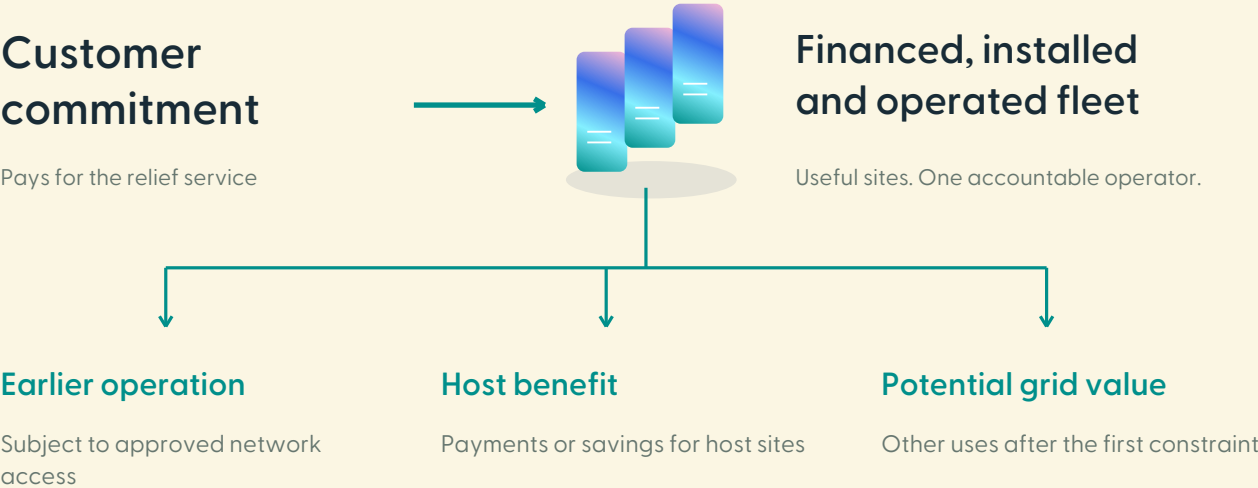
DISTRIBUTED CAPACITY

A first customer. A wider purpose.

Distributed Capacity starts with a customer that needs power sooner. Its contract helps finance a battery fleet. Host businesses share in the value, and we build and run the service. SP directs its use under an approved arrangement, while the authorities retain control over network access.

One customer's need gives the batteries their first job. The wider opportunity is to build useful infrastructure that serves Singapore beyond that job.

CUSTOMER FUNDING BUILDS A BATTERY FLEET



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[4] The Value of Compute Load

valueofcomputeload.info

[5] Brooklyn–Queens Demand Management (BQDM)

Con Edison. Prescriptive Energy Storage System Incentive Offering: 2024 Participant Guide.

[6] Smarter Network Storage (SNS)

UK Power Networks.

[7] The Value Stack Reference Guide for Energy Storage Developers

NYSERDA. July 2020.

[8] Value Stack Credits Statement

National Grid / Niagara Mohawk Power Corporation.

[9] DSO Performance Panel Report 2025/26

UK Power Networks.

ADDITIONAL SOURCE

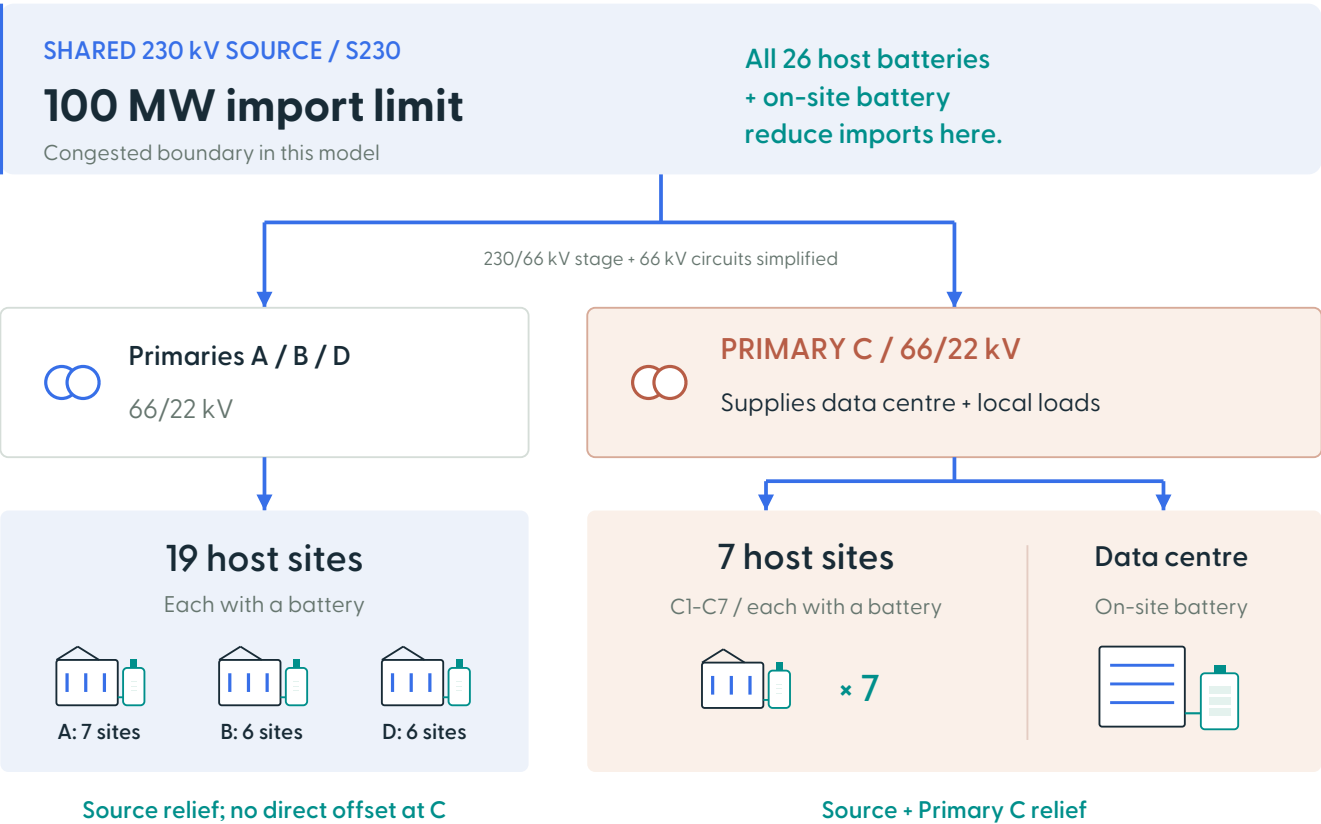
CBRE, Global Data Center Trends 2026. Rental benchmark used in Section 5.1.

ANNEX A / SYNTHETIC NETWORK SIMULATION

One shared constraint. Different local loading.

We use a constructed network to show why battery location matters. All 26 host batteries reduce imports at the shared 230 kV source. Only those behind the data centre's 66/22 kV transformer directly reduce loading on that transformer.

FOLLOW THE SUPPLY PATH



With ties open, A/B/D batteries reduce shared-source imports. C1-C7 and the on-site battery also directly offset demand through Primary C.

Full network: A-2 / Matched comparison: A-3

The same relief at the shared source can leave different loads on the local transformer.

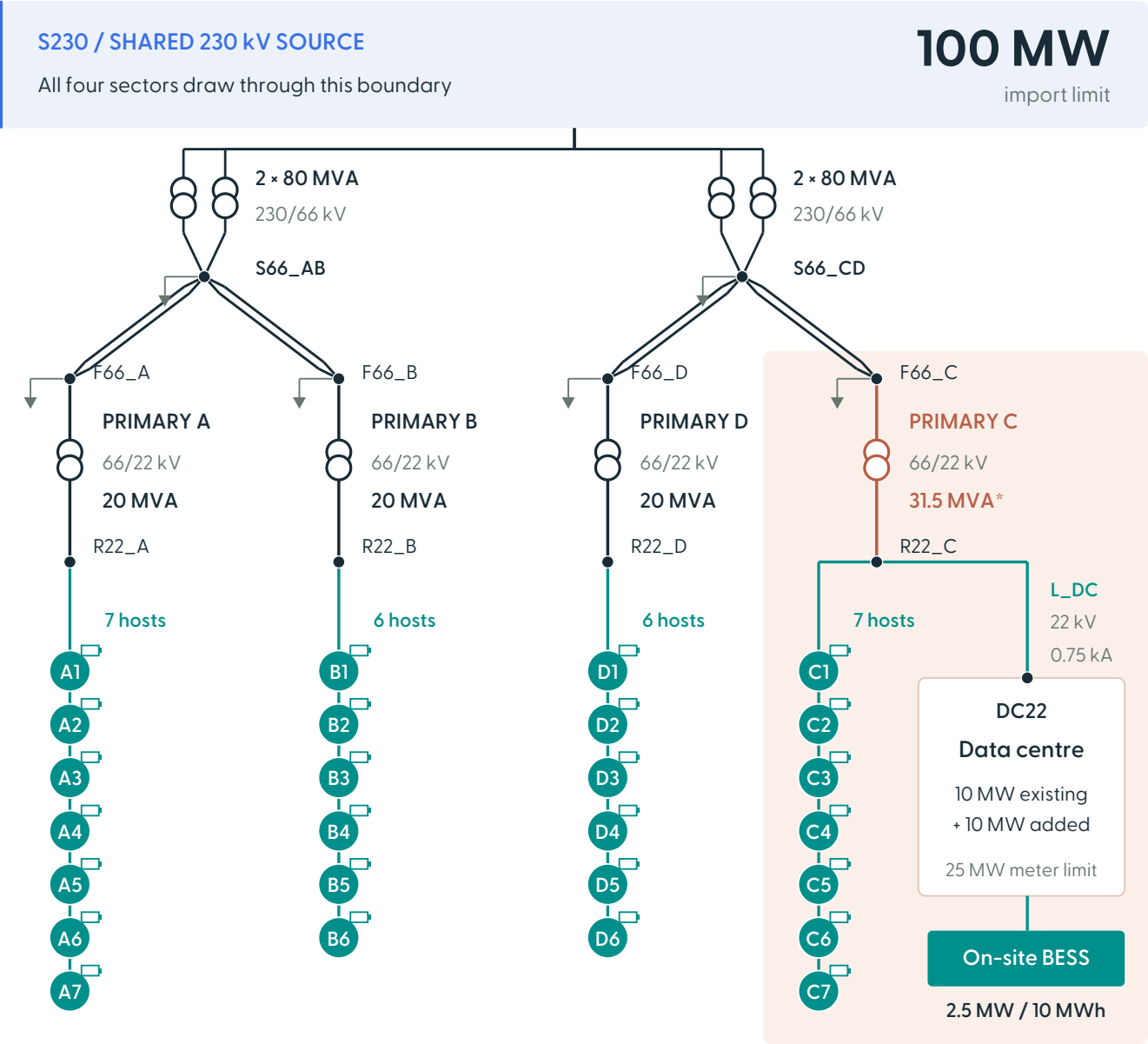
Scope: an hourly steady-state AC simulation on a synthetic network, with battery outages known before scheduling and local connection capacity assumed available. It does not test sudden failures or N-1 security and is not an SP Group connection assessment.

Source: Blue Whale Energy, Why electrical location determines battery value (24 September 2026). No new simulations.

A.2 / SYNTHETIC ELECTRICAL SCHEMATIC

The study network

38 buses / 47 circuits / 27 separately metered batteries



NORMALLY OPEN TIES / EXACT ENDPOINTS

TIE AB / OPEN	TIE BC / OPEN	TIE CD / OPEN	TIE DA / OPEN
A7 ----- / ----- R22_B	B6 ----- / ----- R22_C	C7 ----- / ----- R22_D	D6 ----- / ----- R22_A

Figure A1. Each host: 0.5 MW / 2 MWh. Total fleet: 15.5 MW / 62 MWh nameplate.

Solid lines: connected circuits; pairs: two 66 kV circuits. Triangles: other demand. Shading: C-sector hosts and on-site BESS share Primary C.

22 kV ratings: host chains 0.4 kA; open ties 0.25 kA; customer spur 0.75 kA. * Primary C: 31.5 MVA standard / 30 MVA sensitivity. Source cap is a separate MW limit. Synthetic ratings and schematic distances; not an installation design.

A.3 / SIMULATED BATTERY UNAVAILABILITY

What happens when batteries are unavailable?

We make the on-site battery and three host batteries unavailable, then schedule the remaining fleet. Host demand stays the same. We compare loading at the shared source and the transformer serving the data centre.

4 BATTERIES UNAVAILABLE / 23 HOST BATTERIES REMAIN

The 23 remaining host batteries (11.5 MW / 46 MWh nameplate) supply 8.5 MW from 16:00 to 20:00. Unavailability is known before scheduling; sudden-failure response is not simulated.

CASE 1

3 host batteries unavailable outside the customer sector

A7, B6, D6 + on-site battery



CASE 2

3 host batteries unavailable within the customer sector

C5, C6, C7 + on-site battery



TABLE A1 / DISPATCH AND NETWORK EFFECT

	Case 1	Case 2
Surviving fleet discharge	8.50 MW	8.50 MW
Shared source S230 / 100 MW cap	99.52 MW	99.53 MW
Battery output behind Primary C	2.59 MW	1.48 MW

UPSTREAM SUBSTATION / PRIMARY C TRANSFORMER

30 MVA rating sensitivity



Loading is solved transformer current / continuous rated current at nominal voltage. Both cases use zero battery reactive output and the same network configuration.

HOW THE TRANSFORMER RATING CHANGES THE RESULT

Both cases stay within the standard 31.5 MVA rating. The source study also shows that modelled reactive support removes the overload at 30 MVA. Battery location changes loading; the transformer rating and controls determine whether it exceeds the limit.

Same 8.5 MW fleet output. Both pass the shared-source limit. Only Case 2 exceeds Primary C's tighter limit.